(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
15 November 2001 (15.11.2001)

PCT

(10) International Publication Number
WO 01/85293 A1

(51) International Patent Classification[7]: A63F 13/12

(21) International Application Number: PCT/US00/12783

(22) International Filing Date: 10 May 2000 (10.05.2000)

(25) Filing Language: English

(26) Publication Language: English

(71) Applicant *(for all designated States except US)*: **SIMATION, INC.** [US/US]; P.O. Box 1984, Cranberry Township, PA 16066 (US).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: **LOEFFLER, Carl, Eugene** [US/US]; 141 Farm Street, Fombell, PA 16123 (US).

(74) Agents: **SINGER, James, M.** et al.; 500 Grant Street, 50th Floor, Pittsburgh, PA 15219 (US).

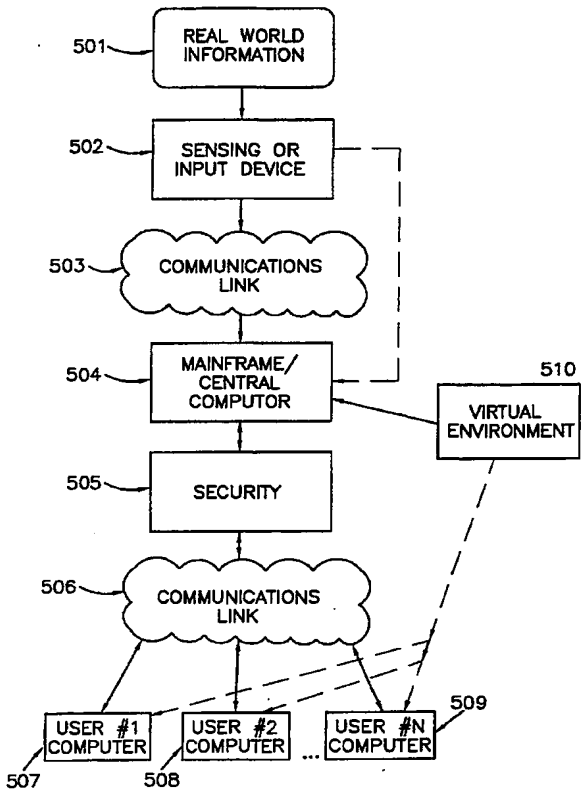
(81) Designated States *(national)*: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

[Continued on next page]

(54) Title: METHOD AND SYSTEM FOR PROVIDING A DYNAMIC VIRTUAL ENVIRONMENT USING DATA STREAMING



(57) Abstract: A computer implemented and/or assisted system presents one or more end users with a dynamic, three-tiered virtual reality environment. The environment includes one or more static backgrounds, one or more users in the form of avatars, and a real-time or delayed presentation of audio and/or visual events through the introduction of a data stream. The user, as an avatar, may view the event from multiple positions, directions and angles while moving about the virtual environment. The content of the data stream is not dependent or relative to the actions of the user or pre-programmed factors. Rather, the content represents actual, real-time or formerly real-time events to provide the users with a dynamic, virtual event that may be experienced on the user's computer screen.

WO 01/85293 A1

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

METHOD AND SYSTEM FOR PROVIDING A DYNAMIC VIRTUAL ENVIRONMENT USING DATA STREAMING

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention generally relates to a computer implemented and/or assisted system and process for displaying dynamic video, audio or alphanumeric information in a virtual reality environment using data streaming.

Background of the Related Art

Virtual reality ("VR") is a computer-implemented and/or assisted representation of reality in three dimensions. The use of VR often revolves around "tele-existence," or the projection of one or more individuals (referred to as "avatars") into a quasi-realistic predetermined environment, as well as the maintenance of consistency within the virtual environment. VR environments may also include one or more agents, or entities within the environment whose actions are predetermined in response to end-user actions. VR applications typically focus on either inter-avatar activity or avatar/environment (including avatar/agent) interaction. Movement and interaction of each avatar is caused by user-initiated actions. For example, in a video game, players may often compete against each other as avatars, or against pre-

defined agents, in one or more of a limited number of fixed virtual environments.

Virtual environments have numerous applications. For example, high-profile Internet sites are highly competitive. The Internet has accelerated the classic business problem of attracting and retaining prospects or visitors to individual sites. Internet users increasingly seek, and Internet site owners increasingly seek to provide, rich, interesting, dynamic environments to work and play on-line. VR can also be useful for business training and operational applications.

Prior art attempts to create or enhance a virtual environment may be found in: (i) U.S. Patent No. 5,958,012, to Battat et al., incorporated herein by reference, which describes a system and apparatus for visualizing the components of a computer network system as a three-dimensional virtual environment; (ii) U.S. Patent No. 6,036,601, to Heckel, incorporated herein by reference, which describes a non-interactive method of advertising within virtual game screen environments on the Internet; and (iii) U.S. Patent No. 5,917,495, to Doi et al., incorporated herein by reference, which describes an apparatus and method for presenting information in a virtual

environment in which a user can feel presence as actual space.

All of the prior art virtual environments have several disadvantages. The prior art environments have either: (i) provided a static environment (e.g., a predefined room having predefined walls, windows, doors, etc.); or (ii) attempted to provide a "pseudo-dynamic" environment by allowing the user to select from or move between several static environments. An example of a static environment is a racetrack game in which the user is provided with a single racetrack per game. An example of a "pseudo-dynamic" environment may be found in a multi-level video game in which the user, as an avatar, moves through several rooms or levels based on game performance and user-selected actions. Such environments, in the consumer context, have limited appeal, as consumers may become disinterested in a fixed or "pseudo-dynamic" environment. In the business context, such environments have limited use because they do not allow for the inclusion of real-time, delayed or stored dynamic information into the virtual environment.

Without provisions for the inclusion of dynamic information, the prior art virtual environment methods and/or systems fail to allow for the alteration of the

environment without human intervention. They also fail to allow for the dynamic translation of real-time and/or real-world information or representations into the virtual environment. In addition, the prior art methods and/or systems of providing virtual environments also fail to maximize or optimize delivery of data to the user over the available bandwidth.

I have determined that if streaming video, audio, alphanumeric or binary data were streamed into a three-dimensional virtual environment, user enjoyment would be enhanced by the richness of the resulting dynamic environment. Internet site owners and virtual software developers would benefit from the number of consumers who would seek such environments. Developers and users of business applications could also benefit from the availability of VR environments that can include streaming real-time, delayed-time or stored elements. In addition, on-line communities could be enhanced as numerous users react to and interact around a common event. Further, business system controls could provide enhanced coordination of operations by providing virtual representations of actual, dynamic spaces.

Adding a data stream representative of three-dimensional real world events to a three-dimensional

VR environment provides several advantages. It expands the market for VR applications be allowing users to experience the presence of other users, as avatars, while sharing or experiencing the same event at the same time. Audio/video events may include, for example, concerts, sports, lectures or other group events that may interest consumers. When business control information or control systems are the data source, applications include in-plant control and near-limitless application in logistics, including warehousing, container shipping and freight.

Accordingly, I have determined that it is desirable to provide a method and/or system that allows streaming audio, video, alphanumeric and/or binary data to be included in a three-dimensional virtual environment.

I have also determined that it is desirable to provide a method and/or system for providing a virtual environment that allows for the alteration of the environment without human intervention.

I have also determined that it is desirable to provide a method and/or system that allows for the dynamic translation of real-time and/or real-world information or representations into a virtual environment.

I have also determined that it is desirable to provide a method and/or system for providing a virtual environment that maximizes and/or optimizes the delivery of data to the user based on the available bandwidth.

I have also determined that it is desirable to provide a method and/or system for providing a virtual environment that allows users to react to and interact around a common event.

I have also determined that it is desirable to provide a method and/or system for providing virtual representations of actual, dynamic spaces for business applications.

SUMMARY OF THE INVENTION

It is therefore a feature and advantage of the present invention to provide a method and/or system that allows streaming audio, video, alphanumeric and/or binary data to be included in a three-dimensional virtual environment.

It is another feature and advantage of the present invention to provide a method and/or system for providing a virtual environment that allows for the alteration of the environment without human intervention.

It is another feature and advantage of the present invention to provide a method and/or system for providing a virtual environment that maximizes and/or optimizes the delivery of data to the user based on the available bandwidth.

It is another feature and advantage of the present invention to provide a method and/or system that allows for the dynamic translation of real-time and/or real-world information or representations into a virtual environment.

It is another feature and advantage of the present invention to provide a method and/or system for providing a virtual environment that allows users to react to and interact around a common event.

It is another feature and advantage of the present invention to provide a method and/or system for providing virtual representations of actual, dynamic spaces for business applications.

The above and other features and advantages are achieved though the use of a novel virtual environment presentation system and method as herein disclosed. In accordance with the preferred embodiment of the present invention, streaming data representative of video images and/or audio sound and/or alphanumeric text is collected from the real world by one or more sensing devices. The streaming data is translated

into a video, audio or text format for display using a computer system equipped with a browser or equivalent software. The computer and browser present a predetermined, three-dimensional, virtual environment to the user and also present the translated streaming data to the user within the virtual environment. Graphical video images, and optionally representations of text, are presented in a three-dimensional format.

There has thus been outlined, rather broadly, the more important features of the invention in order that the detailed description thereof that follows may be better understood, and in order that the present contribution to the art may be better appreciated. There are, of course, additional features of the invention that will be described hereinafter and which will form the subject matter of the claims appended hereto.

In this respect, before explaining at least one embodiment of the invention in detail, it is to be understood that the invention is not limited in its application to the details of construction and to the arrangements of the components set forth in the following description or illustrated in the drawings. The invention is capable of other embodiments and of being practiced and carried out in various ways.

Also, it is to be understood that the phraseology and terminology employed herein are for the purpose of description and should not be regarded as limiting.

As such, those skilled in the art will appreciate that the conception upon which this disclosure is based may readily be utilized as a basis for the designing of other structures, methods and systems for carrying out the several purposes of the present invention. It is important, therefore, that the claims be regarded as including such equivalent constructions insofar as they do not depart from the spirit and scope of the present invention.

Further, the purpose of the foregoing abstract is to enable the U.S. Patent and Trademark Office and the public generally, and especially the scientists, engineers and practitioners in the art who are not familiar with patent or legal terms or phraseology, to determine quickly from a cursory inspection the nature and essence of the technical disclosure of the application. The abstract is neither intended to define the invention of the application, which is measured by the claims, nor is it intended to be limiting as to the scope of the invention in any way.

The scope of the invention, together with other objects of the invention, along with the various features of novelty which characterize the invention,

are pointed out with particularity in the claims annexed to and forming a part of this disclosure. For a better understanding of the invention, its operating advantages and the specific objects attained by its uses, reference should be had to the accompanying drawings and descriptive matter which illustrate preferred embodiments of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates a computer of a type suitable for implementing and/or assisting in the implementation of the processes described herein;

FIG. 2 is a block diagram illustrating the components of a central computer system, which is used in a preferred embodiment of the present invention;

FIG. 3 is a block diagram of the primary components of the system process;

FIG. 4 illustrates the steps of translating the data stream for presentation to the user or users in a virtual environment; and

FIG. 5 illustrates a client/server or user/network relationship of a type suitable for implementing and/or assisting in the implementation of the processes described herein.

Notations and Nomenclature

The detailed descriptions which follow may be presented in terms of program procedures executed on a computer or network of computers. These procedural descriptions and representations are the means used by those skilled in the art to most effectively convey the substance of their work to others skilled in the art.

A procedure is here, and generally, conceived to be a self-consistent sequence of steps leading to a desired result. These steps are those requiring physical manipulations of physical quantities. Usually, though not necessarily, these quantities take the form of electrical or magnetic signals capable of being stored, transferred, combined, compared and otherwise manipulated. It proves convenient at times, principally for reasons of common usage, to refer to these signals as bits, values, elements, symbols, characters, terms, numbers, or the like. It should be noted, however, that all of these and similar terms are to be associated with the appropriate physical quantities and are merely convenient labels applied to these quantities.

Further, the manipulations performed are often referred to in terms, such as adding or comparing, which are commonly associated with mental operations performed by a human operator. While the present

invention contemplates the use of an operator to access the invention, a human operator is not necessary, or desirable in most cases, to perform the actual functions described herein which form part of the present invention; the operations are machine operations. Useful machines for performing the operation of the present invention include general purpose digital computers or similar devices.

The present invention also relates to an apparatus for performing these operations. This apparatus may be specially constructed for the required purpose or it may comprise a general purpose computer as selectively activated or reconfigured by a computer program stored in the computer. The procedures presented herein are not inherently related to a particular computer or other apparatus. Various general purpose machines may be used with programs written in accordance with the teachings herein, or it may prove more convenient to construct a more specialized apparatus to perform the required method steps. The required structure for a variety of these machines will appear from the description given.

DESCRIPTION OF THE PREFERRED EMBODIMENT OF THE INVENTION

The present invention is a computer implemented and/or assisted system and process for displaying dynamic video, audio or alphanumeric information in a virtual reality environment using data streaming. The invention requires a server or network of serving computers, one or more user computers, and a means for communicating between the server or network and the user computer.

FIG. 1 illustrates a computer of a type suitable for carrying out and/or comprising the system of the invention. Viewed externally in FIG.1, a computer system designated by reference numeral 101 has a central processing unit and disk drives 103 and 104. Disk drives 103 and 104 are merely symbolic of a number of disk drives which might be accommodated by the computer system. Typically these would include a hard disk drive and optionally one or more floppy disk drives such as 103 and/or one or more CD-ROMs, CD-Rs, CD-RWs or digital video disk devices indicated by slot 104. The number and types of drives typically varies with different computer configurations. Disk drives 103 and 104 are in fact options, and they may be omitted from the computer system used in connection with the processes described herein.

The computer also has a display 105 upon which graphical, video and/or alphanumeric information is

displayed. The display may be any device capable of presenting visual images, such as a computer monitor, a projection device, or even a device such as a headset or helmet worn by the user to present visual images to the user's eyes. The display is optional for the server or the network of computers described herein. An optional keyboard 106 and a directing device 107 such as a mouse, joystick, touch pad, track ball, steering wheel, remote control or any other type of pointing or directing device may be provided as input devices to interface with the central processing unit. To increase input efficiency, the keyboard 106 may be supplemented with or replaced by a scanner, card reader or other data input device.

Optionally the computer and display may exist in the format of a television and a computing device such as a set top box that performs the functions of a computer. The computing device receives inputs from the user's directional device and presents video and/or audio formatted data to the user via the television screen.

FIG. 2 illustrates a block diagram of the internal hardware of the computer of FIG. 1. A bus 256 serves as the main information highway interconnecting the other components of the computer. CPU 258 is the central processing unit of the system,

performing calculations and logic operations required to execute a program. Read only memory (ROM) 260 and random access memory (RAM) 262 constitute the main memory of the computer.

A disk controller 264 interfaces one or more disk drives to the system bus 256. These disk drives may be external or internal floppy disk drives such as 270, external or internal CD-ROM, CD-R, CD-RW or digital video disk drives such as 266, or external or internal hard drives 268. As indicated previously, these various disk drives and disk controllers are optional devices.

A display interface 272 permits information from the bus 256 to be displayed on the display 248 in audio or alphanumeric format. Again as indicated, the display 248 is also an optional accessory for the network or server. The user's display may optionally be a television device, computer monitor, LCD display, headset, or other device. An audio interface 280 such as a sound card permits information from the bus 256 to be presented in audio format using one or more speakers 282 or other audio presentation devices such as headphones and the like. Communication with external devices may optionally occur using communication port 274.

In addition to the standard components of the computer, the computer also includes an interface 254 which allows for data input through the keyboard 250 or other input device and/or the directional or pointing device 252 such as a mouse or joystick.

FIG. 3 illustrates the primary components of the method for providing a dynamic virtual environment. Real world information 301 having a visual component and an optional audio component is collected using one or more input or collecting or sensing devices 302. The real world information 301 is data representative of a dynamic event, which may include, for example, the audio and visual elements of a concert, a lecture, a sporting event, or a remote room, area or other location such as a road, port, warehouse, building, city, or an underground tunnel or mine. Optionally, the real world information may also be virtual or animated presentations that are representative of or a simulation of real world information. The one or more input or collecting or sensing devices 302 may include, for example, a camera, microphone, infrared sensing device, scanner, bar coding device, sonic sensing device, heat sensitive device, and/or any other means capable of gathering data representative of real world objects, actions and events.

The input and/or sensing device transforms the real world information into a data stream suitable for computer transmission, storage and/or use, such as streamable alphanumeric or binary or digital data. The data representative of real world information is optionally stored in a storage device 303, which may be located on the server, on one or more of the network computers, or on the user's computer. The user's computer includes a means for transforming streaming data into presentable audio, visual and/or alphanumeric format such as a browser 304 and one or more optional plug-ins having such functionality.

A three-dimensional virtual environment 306 is optionally and preferably stored in storage 303 on, and/or generated by, a server or network computer that performs housekeeping tasks necessary to maintain the predefined virtual environment consistently to one or more end users. The virtual environment may optionally include one or more agents (i.e., entities within the virtual environment that are either predetermined or generated by the virtual environment) whose actions are predetermined in response to the actions of the user or users. The housekeeping tasks may include, for example, determining the information each end user needs to see a display that accurately reflects the current state and portion of the environment and the

user's position within the environment; placing the information into a prioritized queue; monitoring communication of the information; receiving information from user's browsers 304; and/or processing or forwarding for processing avatar and agent information.

The three-dimensional virtual environment 306 is presented to the user on a display device via the browser 304 or equivalent software having the capability of presenting visual information to the user. The browser receives and interprets information from the server and/or network computer, resulting in a depiction of the three-dimensional virtual environment on the user's computer system display. The browser is optionally and preferably equipped and/or supplemented with one or more plug-in applications that assist in the presentation of real-time, streaming data in audio and/or visual format.

One or more users, represented by avatars in the virtual environment, experience the streaming data within the virtual environment 307 and move about the environment via a graphical user interface (GUI) 305 using the computer's directional and/or input device such as a joystick, keyboard, mouse, touch pad, or other device. The GUI 405 may respond to the user's/avatar's movements by directing the input or

sensing devices 302 to retrieve the streaming data representative of real world information from a different angle, position or direction 308. The user may then experience the data stream in three dimensions as the user moves about the virtual environment. The data stream is periodically or continually updated as the input or sensing device collects additional information.

Optionally, the input/sensing device 302 automatically collects the streaming data representative of real world information 301 from multiple positions, angles or directions, and the GUI and browser present to the user only the portion of such data that is appropriate for the user to experience based on the user's position within the virtual environment.

FIG. 4 illustrates the steps of translating the data stream for presentation to the user or users in the virtual environment. The data stream 401 is gathered by the input and/or sensing device and pre-processed 402 or converted into a computer-readable and/or transmissible format such as binary, alphanumeric or other digital code. Optionally, certain requirements 403 such as user-responsive directional or angle of view requirements may be included in the pre-processing step. The data stream

may also be modified, restricted or otherwise processed to include specific properties 404, such as size, shape, color, and/or duration limitations to accommodate placement of the data stream into the virtual environment. The data stream is then translated into a format that may be likened to that of a self-modifying agent and placed into the virtual environment 405. The virtual environment is then presented 406 to the user or users to include the predetermined virtual environment and the data stream transformed as a self-modifying agent in a manner that is responsive to the actions of the user or users.

FIG. 5 is a block diagram of an additional embodiment of the hardware design of the present invention using a client/server or user/network relationship. An input or sensing device 502 collects real world information 501 and transforms the information into a format suitable for computer transmission, storage and/or use, such as into binary, digital or alphanumeric data. The sensing device 502 transmits the transformed information to a mainframe, server or central computer 502 through a communications link 503, which may, for example, be a telephone and telephone line, the Internet, a wireless or satellite transmission, or a cable. Optionally, the sensing or input device 502 may be connected directly

to or integral with the central computer 504, thus eliminating the need for a communications link or replacing the communications link with a direct connection. Optionally, the transformed information may be stored in a storage means, which may be part of or connected to the sensing or input device 502, the communications link 503, or the central computer 504.

A three-dimensional virtual environment 510 is presented to one or more users on each user's computer 507-509 through one of two methods. First, the virtual environment 510 may be generated at or by the user's computer 507-509 based on information contained in a storage medium such as a hard drive, floppy disk, CD-ROM or the like as represented in FIGs. 1 and 2. In the alternative, the virtual environment 510 may be generated at or by the mainframe, server or central computer 504 and transmitted to each user's computer 507-509 through a communications link 506. The communications link 506 may be, for example, a telephone and telephone line, the Internet, a direct cable connection, a wireless or cellular or satellite transmission, a cable and cable modem, or any device capable of transmitting the virtual environment from the server to each user. Optionally, a security layer 505 is used to ensure that only users who are authorized to receive the virtual environment actually

receive the virtual environment. The security layer may include, for example, a firewall, a password entry and verification process, an automated identity verification process such as the use of "cookies," or any means of ensuring that only authorized users receive the virtual environment.

The transformed real world information is also transmitted from the server 505 to each user 507-509 via the communication link 506. The communications link 506 may be, for example, a telephone and telephone line and modem, the Internet, a direct cable connection, a cable and cable modem, a wireless or cellular or satellite transmission, or any device capable of transmitting the transformed real world information from the server to each user. Optionally, a security layer 505 is used to ensure that only users who are authorized to receive the transformed real world information actually receive the transformed real world information. The security layer may include, for example, a firewall, a password entry and verification process, an automated identity verification process such as the use of "cookies," or any means of ensuring that only authorized users receive the transformed real world information. Each user may select an individual view of the virtual environment 510 and/or real world information by

sending a command, via an input or directional device at the user's computer, to the server through the communications link. The real world information is periodically or continually updated and presented to each user based on both changes in the information and changes in the view selected by the user.

As additional explanation, in the present invention video images and/or audio sound and/or alphanumeric text are collected from the real world by one or more sensing devices. The streaming data is translated into a video, audio or text format for display using a computer system equipped with a browser or equivalent software. The computer and browser present a predetermined, three-dimensional, virtual environment to the user and also present the translated streaming data to the user within the virtual environment. Graphical video images, and optionally representations of text, are presented in a three-dimensional format. The actions presented by the data stream are not responsive to the actions of the user, but rather are determined by external factors, i.e., what is happening or what happened in the real world when the input device 302 gathered the information. The actions presented may be likened to a self-morphing agent, with actions that reflect the actual properties of the data stream at any point in

time. Unlike prior art agents, however, the self-morphing agent's actions are not pre-determined or pre-programmed through human intervention (except to the optional extent that such actions may include causing the agent's actions to be stored in storage).

Examples of Internet or consumer software-based environments that can be created or enhanced with data streaming include on-line concert forums, on-line shopping destinations, and vertical applications such as creating a virtual alumni viewing area for a college sports event or hosting an on-line conference or convention. For example, in a virtual concert forum, the typical static environment could include the three-dimensional forum itself (walls, floor, stage, etc.), and one or more users could enter the hall as viewer and/or participant avatars. The users' experience would be enhanced if a performer or performers (such as a music group) were inserted onto the stage through streaming data in a live-action format. The streaming data may originate, for example, from an actual, real-time concert in which the performers were being filmed and recorded, the audio data and visual data were converted to a digital data stream, the digital data stream was inserted into the virtual environment, and the data stream was transformed back to a real-time virtual representation

of the band in the virtual concert hall. Instead of being a real-time presentation, the data stream could be pre-recorded and/or stored and streamed into the virtual environment at a later time, either at a predetermined time, at a time selected by the host of the virtual environment, or at a time selected by the user. In such a virtual environment, participants can optionally interact and share with each other their thoughts and/or reactions to the virtual performance as it happens.

When compared with standardized audio/video streams, business control applications have highly individualized data streams. End-user environments also differ for each business application, resulting in increased applications engineering requirements. Examples of business environments that can be created or enhanced with data streaming include operational applications and training modules. For example, a three-dimensional virtual representation of a port or river could also include dynamic representations of water traffic (e.g., boats, barges, etc.), or other items (e.g., cargo being unloaded from a barge) through the insertion of streaming data that is representative of the traffic and/or items. The data stream may be overlaid upon existing control systems within a VR-based supervisory and/or control system.

This reduces project risk and installation complexity while providing a uniform, easy-to-use VR interface that can be maintained when underlying systems are changed. As illustration, for example a container port operator could view a three-dimensional simulation of the entire facility on a computer display. The operator could "see," in three dimensions within the simulation, the ships that are entering the harbor, their relative speeds and their safety clearances. The movements of the ships would be real-world information that enters the virtual environment as a data stream. The operator could also "see" a three dimensional representation of a ship and its cargo, i.e., containers, and could remove the cargo from the ship at a remote location by selecting a three-dimensional representation of the container on the deck of the ship and virtually carrying like, via the computer, to another location. The operator's actions within the virtual environment would be translated to the real world as commands to move a crane and pick up the containers. As the crane and the containers move, the data stream and its position within the simulation would change to represent the present actual location of the crane and the containers in the real world.

The present invention expands the application of virtual environments, including virtual reality modeling language (VRML) based environments, the Sony community place environment and other environments by moving beyond the concept of user-controlled avatars within a static or predetermined set of environments to a three-layer model that also contains the results of exogenous data streams (whether video, audio, alphanumeric, binary, or otherwise) that have been translated and embedded within the VR "world" without active human intervention.

The present invention may be used with any operating system and/or virtual reality standard, including but not limited to, VRML, 3D Studio, ActiveX, Blaxxun3D, BlaChemical Markup Language (CML), cable modems, Community Place, Cosmo, Direct3D, Directory Service Mark up Language (DSML), Document Object Model (DOM), Digital Signal Processor (DSP), Extendable text languages (DirXML/XML/XSL), Flash, Internet Explorer, Java, Linux, Maya, Metastream (MTS), Macintosh OS, Moving Worlds, Netscape, OpenGL, Open Worlds, Personal Data Assistint (PDA), Scalable Vector Graphics (SVG), set top boxes, Sumatra, Unix, WEB3D, Windows, World View, X3D, and Worlds.

The invention allows users (in the form of avatars) to interact in an environment that accurately

reflects the situation described by the exogenous information in real or delayed time. The transformation that places the data stream into the environment can include enhancements to increase user comprehension such as (but not limited to): (i) the translation of data into a physical representation of an object, such as a moving ship, vehicle, person, animal or aircraft; and (ii) the presentation of audio and/or visual cues that can represent real work events and warn of current or impending problems, such as schedule problems, danger of collisions of moving objects, and the like. The resulting three-tier virtual environment (which includes the static background, the data stream, and one or more avatars and/or agents) provides a constantly updated virtual world without any human intervention (other than the optional movement by the user to different locations within the virtual world, thus triggering the presentation of different views of the three-dimensional background and data stream).

The system of using a network or central server provides several advantages. For example, it allows multiple users to "see" the same virtual environment, and thus the virtual events occurring within the virtual environment, at the same time. By transferring the data stream via a server or network,

all users receive the same information at the same time in a comparable form. Server-side software performs the operations necessary to transform the data stream into visual or audio presentation format and then forwards the images and/or sound to the user or users.

The client/server model also provides for efficient use of bandwidth by reducing the total amount information that must be transmitted to end users at any single time by providing a single focal point for all users to send and retrieve information. The concept of VR client/server distributed processing also allows for dynamic adjustment to account for bandwidth differences. In other words, for users having high-speed data connections, more information may be coded and sent to the user. For users having lower speed connections, selected information may be further compressed or omitted, providing the lower speed user images and/or sound that is of somewhat lower resolution or quality than that received by the high-speed user, but of comparable accuracy and currency.

The many features and advantages of the invention are apparent from the detailed specification, and thus, it is intended by the appended claims to cover all such features and advantages of the invention

which fall within the true spirits and scope of the invention. Further, since numerous modifications and variations will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation illustrated and described, and accordingly, all suitable modifications and equivalents may be resorted to, falling within the scope of the invention.

What is claimed is:

1. An interactive computer assisted method of providing a three-dimensional virtual environment to a user comprising:

(a) collecting, using at least one collecting device, data representative of a dynamic event;

(b) generating, using a computer, a three-dimensional virtual environment;

(c) inserting, using the computer, the data representative of a dynamic event into the three-dimensional virtual environment; and

(d) presenting, using a display device, a presentation of the three-dimensional virtual environment and the data representative of a dynamic event to the user.

2. The interactive computer assisted method of providing a three-dimensional virtual environment according to claim 1, further comprising:

(a) receiving, using the computer, a command from the user to present a different view of the three-dimensional virtual environment;

(b) collecting, using the at least one collecting device, additional data representative of

a dynamic event from a direction compatible with the different view selected by the user;

(c) adjusting, using the computer, the presentation of the three-dimensional virtual environment to the user responsive to the different view selected by the user;

(d) inserting, using the computer, the additional data representative of a dynamic event into the three-dimensional virtual environment; and

(e) presenting, using the display device, a presentation of the three-dimensional virtual environment and the additional data representative of a dynamic event to the user.

3. The interactive computer assisted method of providing a three-dimensional virtual environment according to claim 1, further comprising:

(a) collecting, using the at least one collecting device, additional data representative of a dynamic event;

(b) replacing, using the computer, the data representative of a dynamic event with the additional data representative of a dynamic event; and

(c) presenting, using a display device, a presentation of the three-dimensional virtual

environment and the additional data representative of a dynamic event to the user.

4. The interactive computer assisted method of providing a three-dimensional virtual environment according to claim 1, further comprising storing the data representative of a dynamic event in a storage device before inserting the data into the three-dimensional virtual environment.

5. The interactive computer assisted method of claim 1 wherein, after the generating step, a determining step determines a portion of the environment that is responsive to a user input.

6. The interactive computer assisted method of claim 1 including the additional step of verifying the identity of the user.

7. An interactive computer assisted method of providing a three-dimensional virtual environment to at least one user, comprising:

(a) collecting, using at least one collecting device, data representative of a dynamic event;

(b) delivering, using a first communication means, the data representative of a dynamic event to a central computer; and

(c) delivering, using a second communication means, the data representative of a dynamic event to at least one user computer for insertion into a three-dimensional virtual environment; and

(d) presenting, using a display device, the data representative of a dynamic event to at least one user.

8. The interactive computer assisted method of providing a three-dimensional virtual environment according to claim 7, further comprising:

(a) receiving, by the central computer, a command from a requesting user to present a different view of the three-dimensional virtual environment;

(b) collecting, using the at least one collecting device, additional data representative of a dynamic event from a direction compatible with the different view selected by the requesting user;

(d) inserting, using the computer, the additional data representative of a dynamic event into the three-dimensional virtual environment; and

(e) presenting, using the display device, a presentation of the additional data representative of a dynamic event to the requesting user.

9. The interactive computer assisted method of providing a three-dimensional virtual environment according to claim 7, further comprising:

(a) collecting, using the at least one collecting device, additional data representative of a dynamic event;

(b) replacing, using the central computer, the data representative of a dynamic event with the additional data representative of a dynamic event; and

(c) presenting, using a display device, the additional data representative of a dynamic event to the at least one user.

10. The interactive computer assisted method of providing three-dimensional virtual environment according to claim 7, further comprising storing the data representative of a dynamic event in a storage device before inserting the data into the three-dimensional virtual environment.

11. The interactive computer assisted method of claim 7 wherein, after the generating step, a determining step determines a portion of the environment that is responsive to a user input.

12. The interactive computer assisted method of claim 7 including the additional step of verifying the identity of the user.

13. A computer program memory, storing computer instructions to implement a dynamic three-dimensional virtual environment program, the computer instructions including:

(a) collecting, using at least one collecting device, data representative of a dynamic event;

(b) generating, using a computer, a three-dimensional virtual environment;

(c) inserting, using the computer, the data representative of a dynamic event into the three-dimensional virtual environment; and

(d) presenting, using a display device, a presentation of the three-dimensional virtual environment and the data representative of a dynamic event to the user.

14. The computer program memory according to claim 13, the computer instructions further including:

(a) receiving, using the computer, a command from the user to present a different view of the three-dimensional virtual environment;

(b) collecting, using the at least one collecting device, additional data representative of a dynamic event from a direction compatible with the different view selected by the user;

(c) adjusting, using the computer, the presentation of the three-dimensional virtual environment to the user responsive to the different view selected by the user;

(d) inserting, using the computer, the additional data representative of a dynamic event into the three-dimensional virtual environment; and

(e) presenting, using the display device, a presentation of the thee-dimensional virtual environment and the additional data representative of a dynamic event to the user.

15. The computer program memory according to claim 13, the computer instructions further including:

(a) collecting, using the at least one collecting device, additional data representative of a dynamic event;

(b) replacing, using the computer, the data representative of a dynamic event with the additional data representative of a dynamic event; and

(c) presenting, using a display device, a presentation of the three-dimensional virtual environment and the additional data representative of a dynamic event to the user.

16. The computer program memory according to claim 13, the computer instructions further including storing the data representative of a dynamic event in a storage device before inserting the data into the three-dimensional virtual environment.

17. The interactive computer assisted method of claim 13 wherein, after the generating step, a determining step determines a portion of the environment that is responsive to a user input.

18. The interactive computer assisted method of claim 13 including the additional step of verifying the identity of the user.

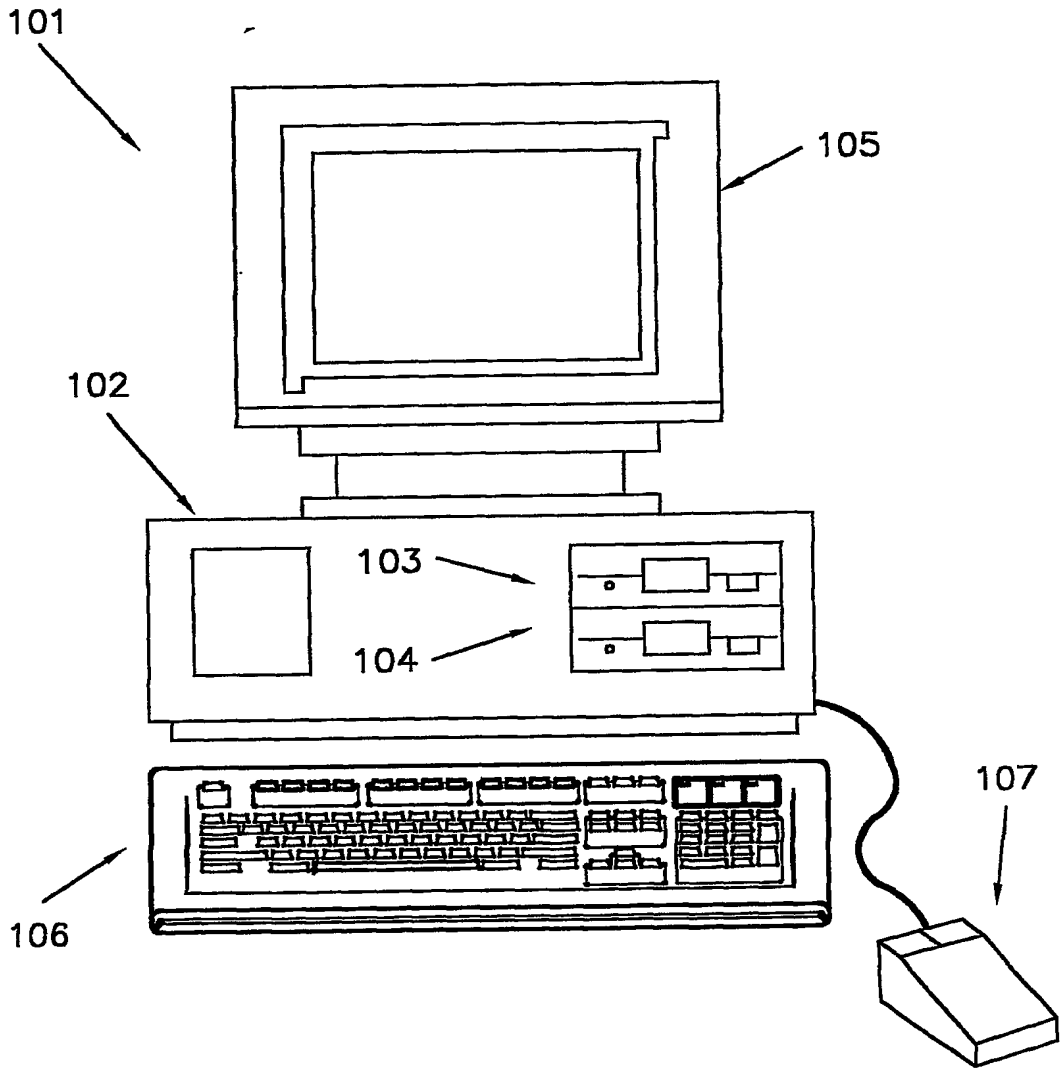


Fig. 1

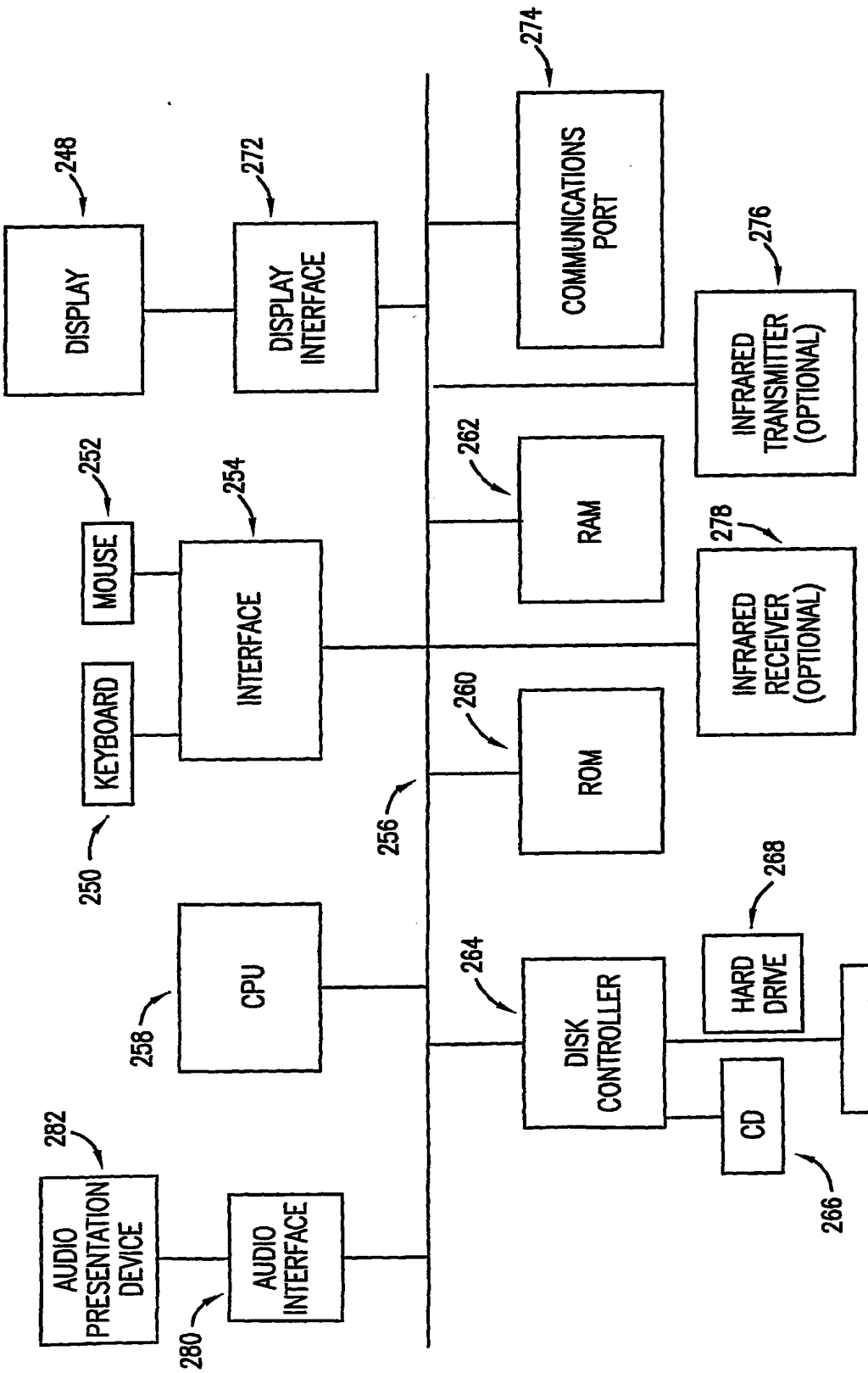

DISPLAY
248
DISPLAY INTERFACE
272
COMMUNICATIONS PORT
274
INFRARED TRANSMITTER (OPTIONAL)
276
RAM
262
MOUSE
252
INTERFACE
254
KEYBOARD
250
INFRARED RECEIVER (OPTIONAL)
278
ROM
260
256
CPU
258
DISK CONTROLLER
264
HARD DRIVE
268
FLOPPY DRIVE
270
CD
266
AUDIO PRESENTATION DEVICE
282
AUDIO INTERFACE
280

Fig. 2

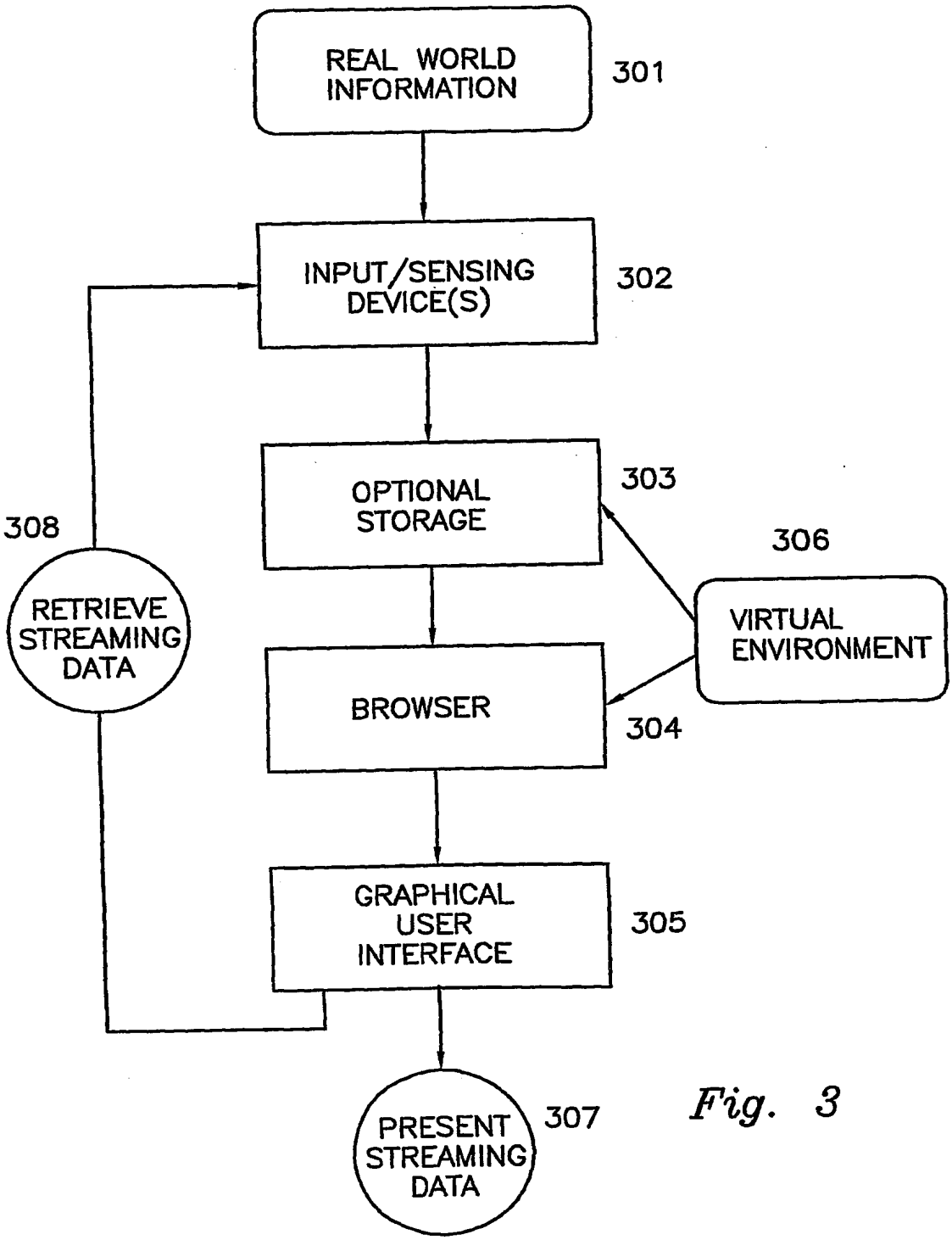

REAL WORLD INFORMATION
301
INPUT/SENSING DEVICE(S)
302
OPTIONAL STORAGE
303
308
306
RETRIEVE STREAMING DATA
VIRTUAL ENVIRONMENT
BROWSER
304
GRAPHICAL USER INTERFACE
305
PRESENT STREAMING DATA
307

Fig. 3

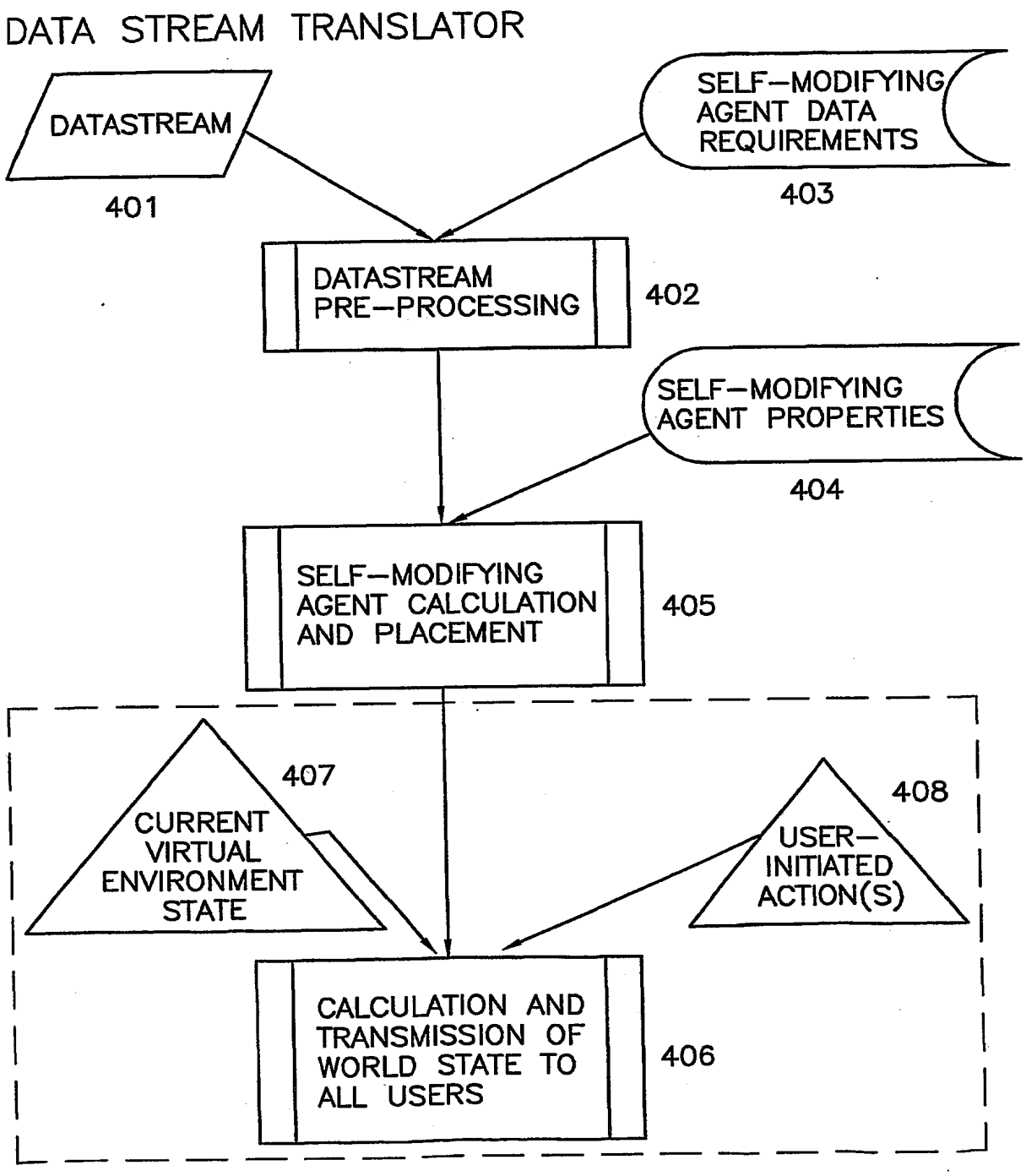

DATA STREAM TRANSLATOR
DATASTREAM
401
SELF–MODIFYING AGENT DATA REQUIREMENTS
403
DATASTREAM PRE–PROCESSING
402
SELF–MODIFYING AGENT PROPERTIES
404
SELF–MODIFYING AGENT CALCULATION AND PLACEMENT
405
407
CURRENT VIRTUAL ENVIRONMENT STATE
408
USER–INITIATED ACTION(S)
CALCULATION AND TRANSMISSION OF WORLD STATE TO ALL USERS
406

Fig. 4

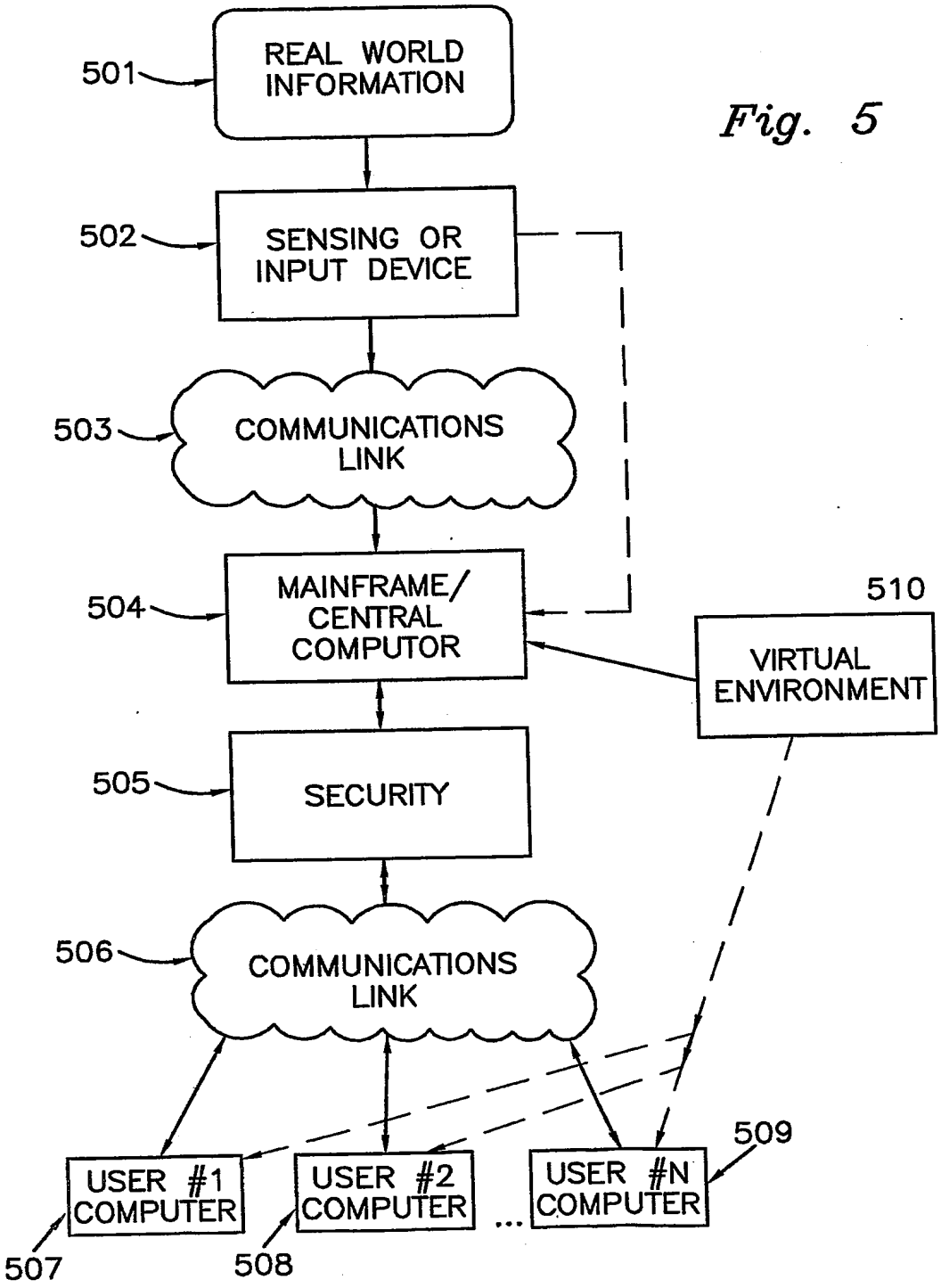

501
REAL WORLD INFORMATION
502
SENSING OR INPUT DEVICE
503
COMMUNICATIONS LINK
504
MAINFRAME/ CENTRAL COMPUTOR
510
VIRTUAL ENVIRONMENT
505
SECURITY
506
COMMUNICATIONS LINK
509
USER #1 COMPUTER
USER #2 COMPUTER
...
USER #N COMPUTER
507
508

Fig. 5

INTERNATIONAL SEARCH REPORT

Inte onal Application No
PCT/US 00/12783

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 A63F13/12

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 A63F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 98 46029 A (GOODMAN CHRISTOPHER ;ORAD HI TEC SYSTEMS LTD (IL); AZAR ZION (IL);) 15 October 1998 (1998-10-15)	1,2,4,5, 7,8,10, 11,13, 14,16,17
Y	page 9, paragraph 5 page 15, paragraph 2 page 17, paragraph 1 page 18, paragraph 2	3,6,9, 12,15,18
X	WO 00 16869 A (FORSBERG SERVICES LIMITED ;FORSBERG CHARLES (GB)) 30 March 2000 (2000-03-30) page 3, paragraph 3 -page 4, paragraph 3 page 6, line 9 - line 20	1,2,4,5, 7,8,10, 11,13, 14,16,17

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 January 2001	30/01/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Sindic, G

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 00/12783

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
X	MOEZZI S ET AL: "An emerging medium: interactive three-dimensional digital video" IEEE MULTIMEDIA, 17 June 1996 (1996-06-17), pages 358-361, XP002145409 page 358, right-hand column, line 7 - line 11 page 358, right-hand column, line 26 -page 359, left-hand column, line 41 figure 1	1,2,7,8, 13,14
Y	EP 0 816 984 A (SUN MICROSYSTEMS INC) 7 January 1998 (1998-01-07) column 14, line 10 - line 19 column 14, line 48 - line 52	3,9,15
Y	US 5 674 127 A (DECKLER WILLIAM E ET AL) 7 October 1997 (1997-10-07) column 3, line 49 - line 56	6,12,18
A	EP 0 990 461 A (SONY CORP) 5 April 2000 (2000-04-05) paragraph '0035! paragraph '0077!	3,9,15

INTERNATIONAL SEARCH REPORT

Information on patent family members

Inte ɔnal Application No
PCT/US 00/12783

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9846029 A	15-10-1998	AU 6413998 A EP 0972409 A	30-10-1998 19-01-2000
WO 0016869 A	30-03-2000	AU 6103099 A	10-04-2000
EP 0816984 A	07-01-1998	US 5886683 A JP 10133810 A	23-03-1999 22-05-1998
US 5674127 A	07-10-1997	US 5947825 A	07-09-1999
EP 0990461 A	05-04-2000	JP 2000113218 A	21-04-2000